

remarkable circumstance suggests the following question. Is this behaviour common also to the corresponding compounds of arsenic, phosphorus and nitrogen, and can the position of each of the five atoms with which these elements respectively combine be occupied indifferently by an electro-negative or an electro-positive element? This question, so important for the advance of our knowledge of the organic bases and their congeners, cannot now long remain unanswered.

5. "On the Dentate Body of the Cerebellum." By William Brinton, M.D. Communicated by R. B. Todd, M.D., F.R.S. &c. Received May 23, 1852.

The corpus dentatum has generally been described and recognised as a wavy line or lamina of grey matter, which is seen in certain sections of the crus of the cerebellum, and contains fibres apparently derived from the restiform body, and the processus e cerebello ad testes. Reil's account, with some vague and conflicting details, gives it a more definitely tubular form, although he is apparently not certain of the continuity of its upper and lower layers posteriorly.

The author explains these somewhat varying descriptions by the physical characters of the tissues investigated, and by the condition—fresh or hardened in spirit—of the specimens examined by different anatomists.

He deduces the form and situation of the recent corpus dentatum by uniting numerous and successive sections made in the three directions of space*. Its arrangement with respect to the fibres of the cerebellum, cerebrum, medulla oblongata, and medulla spinalis, is chiefly deduced from examinations of specimens hardened in alcohol.

By these two methods he is led to the following conclusions, that each corpus dentatum forms a tubular investment to the extremity of the processus e cerebello ad testem; it is open towards the fourth ventricle, and is connected with the opposite body by a commissure of grey matter in its median line. While its interior exclusively receives the fibres of this cerebro-cerebellar peduncle, its exterior radiates fibres to the various lobes of the cerebellum, which fibres, at the bottom of each lobe-stem, become inseparably mixed with a bundle from the restiform body, and with another from the pons varolii.

Its *comparative anatomy* in mammalia corresponds with this view; its *minute anatomy* does not contradict it. And while the *physiological import* of this arrangement eludes all conjecture, the author has little doubt that its anatomical structure and relations are best comprehended in the formula which he would thus assign to it, viz. that of being the cerebro-cerebellar ganglion.

6. "Proof of a sensible difference between the Mercurial and Air-Thermometers from 0° to 100° C." By J. J. Waterston, Esq.

* Diagrams to this effect accompanied the paper.

Communicated by Colonel Sabine, R.A., Treas. V.P.R.S. &c.
Received June 17, 1852.

This paper has reference to a former communication "On a General Law of Density in Saturated Vapours." In the present paper the author states that the formulæ that embrace MM. Dulong and Petit's four standard mean values of the relative expansion of air, mercury and glass, exhibit the temperature by the air-thermometer in advance of the mercurial thermometer, between 0° and 100° C. The amount of difference increases from 0° to 48° , and then diminishes to 100° ; the maximum value being $0^{\circ}.513$. The most eminent modern authorities deny the existence of any such difference, or appear tacitly to admit that it is too small to be observed. For this reason no correction was made on temperatures below 100° in Chart No. 2, where indeed it could hardly be perceptible. Although of little practical importance, this difference, if it exists, cannot safely be neglected in theoretical researches, inasmuch as the value of a degree of the mercurial thermometer must in such case be a variable quantity, differing in the ratio of 23 to 24 from 100° C. to 0° .

Having at last obtained satisfactory proof of the existence and amount of the correction between 0° and 100° , he has thought it of sufficient importance to give a detailed account of the method employed to extract the required evidence from M. Regnault's observations on the tension of low pressure steam.

As the law of density, illustrated in Chart No. 2, has clearly reference to the air-thermometer, if a series of observations were *perfectly* correct, they must *perfectly* exhibit this difference—if it really exists—when projected on the chart; because the divergence from the line that joins the points at 0° and 100° must exactly correspond with the correction required at the intermediate temperatures. In short, the line of density would appear as a curve slightly concave towards the axis, and if the proper correction were made on the temperatures, that curve would be converted into a straight line. This view is illustrated by a sketch, in which the curvature is purposely much exaggerated. In this a straight line is drawn, as the gradient of density, and in which the points range if the temperatures are by the air-thermometer. This line is inclined to the axis x of temperature, at an angle of which h is the cotangent (see 'Proceedings,' vol. vi. p. 98). At points in it corresponding to temperatures 50° , 60° , 70° , &c., straight lines are drawn parallel to the axis x ; and at distances in these equal to the respective computed differences, straight lines are drawn at right angles to the axis x , and meeting the lines of constant pressure drawn through the corresponding points of the straight line which represents the gradient of density. The curved line passing through the points of intersection, is that in which the points of density range if laid off to the temperatures by the mercurial thermometer.

The author then states that the first attempt was made by obtaining the value of the constants g and h ('Proceedings,' vol. vi. p. 98) from the observation at 50° and 100° ; then computing the

intermediate tensions at 60°, 70°, &c., and comparing them with observation. The result is given in the following table:—

TABLE I.

50°	60°	70°	75°	80°	90°	100°	Temp. by mercurial therm.
91·98	148·52	232·22	287·27	353·06	523·71	760	Computed tensions.
91·98	148·79	233·09	288·50	354·64	525·45	760	Observed tensions.
0	+0·27	+0·87	+1·23	+1·58	+1·74	0	Difference.

The same operations were performed with temperatures corrected. The result is given in the following table:—

TABLE II.

50°	60°	70°	75°	80°	90°	100°	Temp. by merc. therm.
50°·512	60°·481	70°·413	75°·366	80°·310	90°·171	100	Temp. by air-therm.
91·98	149·03	233·30	288·60	354·60	525·09	760	Computed tension.
91·98	148·79	233·09	288·50	354·64	525·45	760	Observed tension.
0	-0·24	-0·21	-0·10	+0·04	+0·36	0	Difference.

It is remarked that the differences in the first table show a distinct curvature with reference to the chord; while in the second table the accordance with the straight line is as perfect as could be expected.

With the view of bringing these facts out into higher relief and presenting the deflection to the eye on a scale that should at once be relatively correct and very highly magnified, the author computed six values of h from the observations at 90° and 100°, at 80° and 100°, &c., without correcting the temperatures, by the formula

$$h = \frac{t_2 - t_1}{\sqrt{\frac{p_2}{t_2} - \frac{p_1}{t_1}}}$$

These are given in the following table; they are quantities proportional to the cotangents of the inclination of the chords to the axis of temperature.

TABLE III.

50°	60°	70°	75°	80°	90°	111°·74	Temp. by merc.ther.
158·854	159·025	159·357	159·571	159·816	160·387	165·406	Values of h .
0	+0·171	+0·503	+0·717	+0·962	+1·533	+6·552	Diff. from h at 50°.

The differences in this table are progressively increasing, and their relation to each other is very nearly that of the corresponding differences of the inclination of the chords. They are represented by these inclinations in a figure, and, in order to render the divergence from a straight line more manifest, the scale taken is 10° angular measure to the unit of difference, the length of the chords corre-

sponding with the intervals of temperature below 100° . Joining the extremities of the chords, a magnified view is obtained of the curve determined from observations with temperatures uncorrected. On this the author remarks, that if the temperatures required no correction, the points so determined would lie in a straight line, always taking for granted the integrity of the law of density and the perfect accuracy of the observations.

The next step was to perform the same computation with temperatures corrected. The resulting values of h are given in the following table:—

TABLE IV.

50° 56°·512 157·121	60° 60°·481 156·983	70° 70°·413 157·006	75° 75°·366 157·053	80° 80°·310 157·155	90° 90°·171 157·428	111°·7 111°·50 161·738	Temp. by merc. ther. Temp. by air-therm. Values of h .
0	−0·138	−0·115	−0·068	+0·024	+0·307	4·617	Diff. from h at 50° .

The difference between h at 50° in the two tables being 1·733, a straight line is drawn from the point corresponding to 100° , making an angle of $17^{\circ}·33$, with the chord for 50° in the uncorrected temperatures; and lines are drawn from the same point making angles $1^{\circ}·38$, $1^{\circ}·15$, $0^{\circ}·68$, &c. with this line, the intersections of which with the distances or chords corresponding to the temperatures, give the points which represent on the same magnified scale, the observations with the temperatures corrected. The author remarks that the line joining these points represents the *empirical* law of density, and that its relation to the standard right line for the temperature 50° is precisely what might be expected to subsist between the empirical and true curve of tension. It intersects that line—and *intersection*, not *contact*, is the character of empirical formulæ—at 50° , 75° , and 100° , and at intermediate temperatures diverges from it to the extent of about $\frac{1}{40}$ th of a degree at the maximum.

Thus, he states, M. Regnault's observations between 50° and 100° afford a distinct answer to the inquiry in the affirmative, and it seems no longer possible to doubt that there is a difference between the mercurial and air-thermometers below 100° ; and that its amount does not sensibly differ from the formulæ that embrace MM. Dulong and Petit's standard observations. He annexes these formulæ in a combined form adapted to the Centigrade scale.

$$t_m = \frac{Bt_a}{A - t_a} - \frac{t_a^3}{C^3} - \frac{t_a}{D} \dots\dots\dots (1)$$

t_a = temperature by air-thermometer $\log B = 3·7145723$

t_m = temperature by mercurial thermometer $A = 4539^{\circ}·617$

$\log C = 6·43303$

$\log D = 0·78587$

It would be more convenient if we could express t_a in terms of t_m , but this can only be done approximatively, as in the following :

$$t_a = \frac{t_m}{\frac{B}{A - t_m} - \frac{t_m^2}{C^3} - D} \dots\dots\dots (2)$$

If greater accuracy is required, the rule is to find t_a from t_m by (2), then substitute it in (1), and compute t_m ; this compared with the true value shows the alteration to be made in t_a to obtain its true value.

In conclusion the author observes, it might be expected, without reference to theory, that the curve deduced from the uncorrected temperatures should not show, in its continuation above 100, any abrupt divergence from its regular course; nevertheless from 100° to 111·74 the direction of the chord shows such a break in the law of continuity, and which there appears no way of accounting for, unless by a fault in the observations above 100°. Their divergence from the law of density is shown in the Chart.

The Society then adjourned over the vacation to Thursday, November 18, 1852.

November 18, 1852.

COLONEL SABINE, Treasurer, in the Chair.

In consequence of the public funeral of His Grace the late Duke of Wellington having been fixed for this day, the business of the Meeting, out of respect to the memory of the deceased, was confined to reading the Statute giving notice of the ensuing Anniversary Meeting.

November 25, 1852.

The EARL OF ROSSE, President, in the Chair.

The Rev. B. Price, and Mr. Wyndham Harding were admitted into the Society.

The following Gentlemen were elected Foreign Members of the Society :—

A. T. Brongniart.
Benjamin Peirce.

M. V. Regnault.
Dr. Lamont.

The following papers were read :—

1. "New solution of Kepler's Problem." By Professor P. A. Hansen. Communicated by G. B. Airy, Esq., Astronomer Royal, F.R.S. &c. Received November 18, 1852.

It is well known how much labour has been bestowed by geometers on the solution of Kepler's Problem, and what complicated results have been obtained for the coefficients in the expression for the Equation of the Center. I have lately found a new solution of this problem, which differs so strikingly from former solutions in this respect, that it leads to an unexpectedly simple law of coefficients. It is as follows :—

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